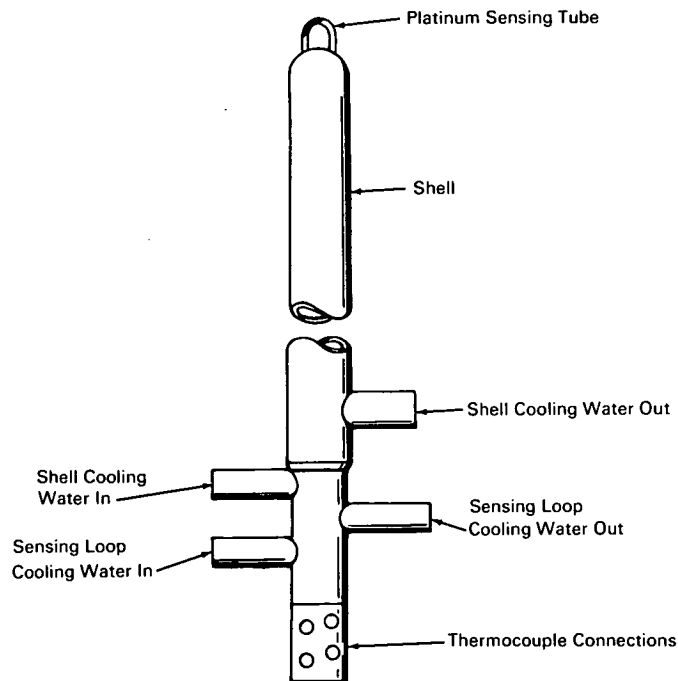


NASA TECH BRIEF



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Internal Cooling Increases Range of Immersion-Type Temperature Probe



The problem: The design of an immersion temperature probe for use in a high-temperature, high-velocity gas stream poses problems that involve compromise between accuracy range and mechanical strength. Thermocouples cannot always be used near the limit of their melting points because aerodynamic loading, erosion, vibration, and fatigue reduce the practical limit well below this point.

The solution: An immersion-type temperature probe that uses a cooled sensing element within a cooled support shell.

How it's done: The outer shell of the probe is cooled by ordinary tap water applied to the inlet at a pressure of 60 psi. Mounted on the tip of the cooled shell is a platinum tube sensing element that is cooled by flowing distilled water at an inlet pressure of 60 psi. A restriction is placed at the outlet of the sensing element tube to limit the flow to a predetermined constant rate. Iron constantan thermocouples, placed at the inlet and outlet nozzles of the sensing tube, measure the temperature difference of the inflowing and outflowing fluid.

(continued overleaf)

Thus, this cooled tube pyrometer uses the principle of a heat transfer balance between the external convective heat transfer from the hot gas stream and the heat gained by the internal coolant of the sensing loop. The heat transfer rate to the probe is determined by measuring the flow rate and temperature rise of the sensing loop coolant. This heat transfer rate can then be related to the gas free-stream temperature after determination of a constant of proportionality by calibration against a reference pyrometer at some convenient lower temperature.

Notes:

1. This probe operated with an accuracy to 2.0% over a temperature range of 1600 to 4400°R, a mach number range of 0.3 to 0.8, and a pressure range of 0.67 to 1.5 atmospheres.
2. This innovation would be useful for high temperature measurements that are beyond the range of thermocouple usage.

3. Further information concerning this innovation is presented in NASA-TN-D-870, "A Cooled Tube Pyrometer with Experimental Results Obtained in a High-Temperature Gas Stream" by George E. Glawe, Robert C. Johnson, and Lloyd N. Krause, August 1961, available from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia, 22151; price \$1.00. Inquiries may also be directed to:

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Patent status: NASA encourages commercial use of this innovation. No patent action is contemplated.

Source: Chester D. Lanzo
(Lewis-171)